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(54) **STRIPPER PLATE AND STITCHING PLATE FOR A NEEDLING MACHINE**

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CPC ***D04H 18/02*** (2013.01)

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USPC 28/115
See application file for complete search history.

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(57) **ABSTRACT**

The stripper plate or stitching plate for a needling machine comprises a plurality of opening arrangements, wherein each opening arrangement comprises at least one opening for accommodating needles of a needle row of a needle board of the needling machine. At least first and second opening arrangements of the plurality of opening arrangements are arranged at a slant to a longitudinal direction (L_1) of the stripper plate or stitching plate, and an absolute value of the angle (β) of the second opening arrangements to the longitudinal direction (L_1) of the stripper plate or stitching

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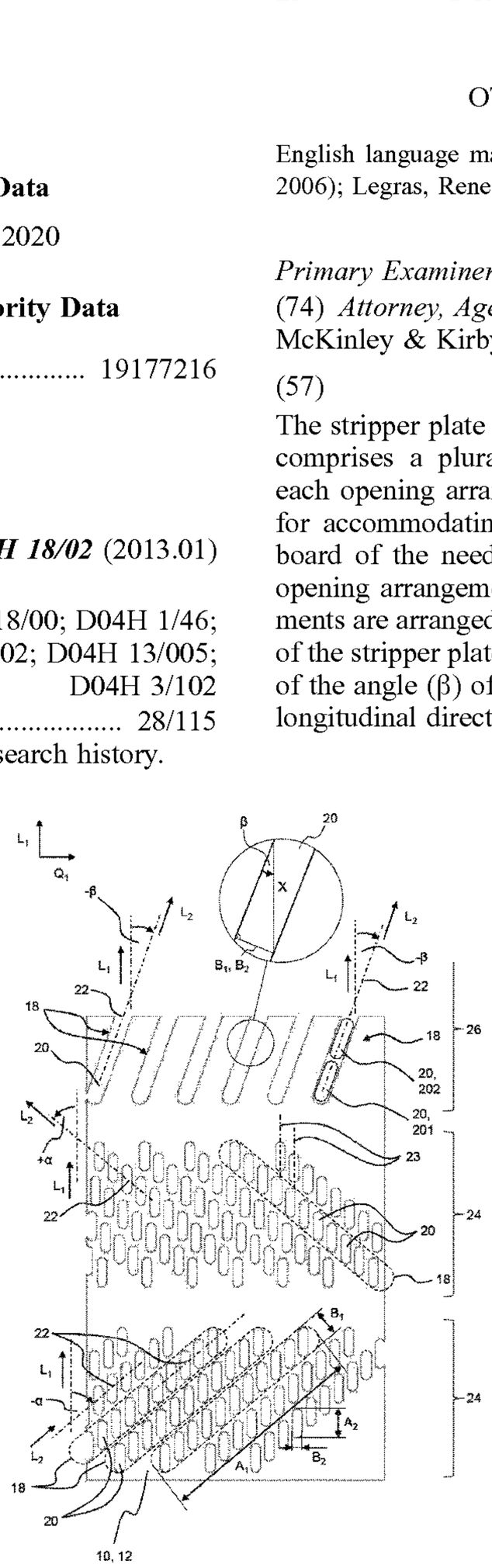

plate is different from an absolute value of an angle (α) of the first opening arrangements to the longitudinal direction (L_1) of the stripper plate or stitching plate.

11 Claims, 3 Drawing Sheets

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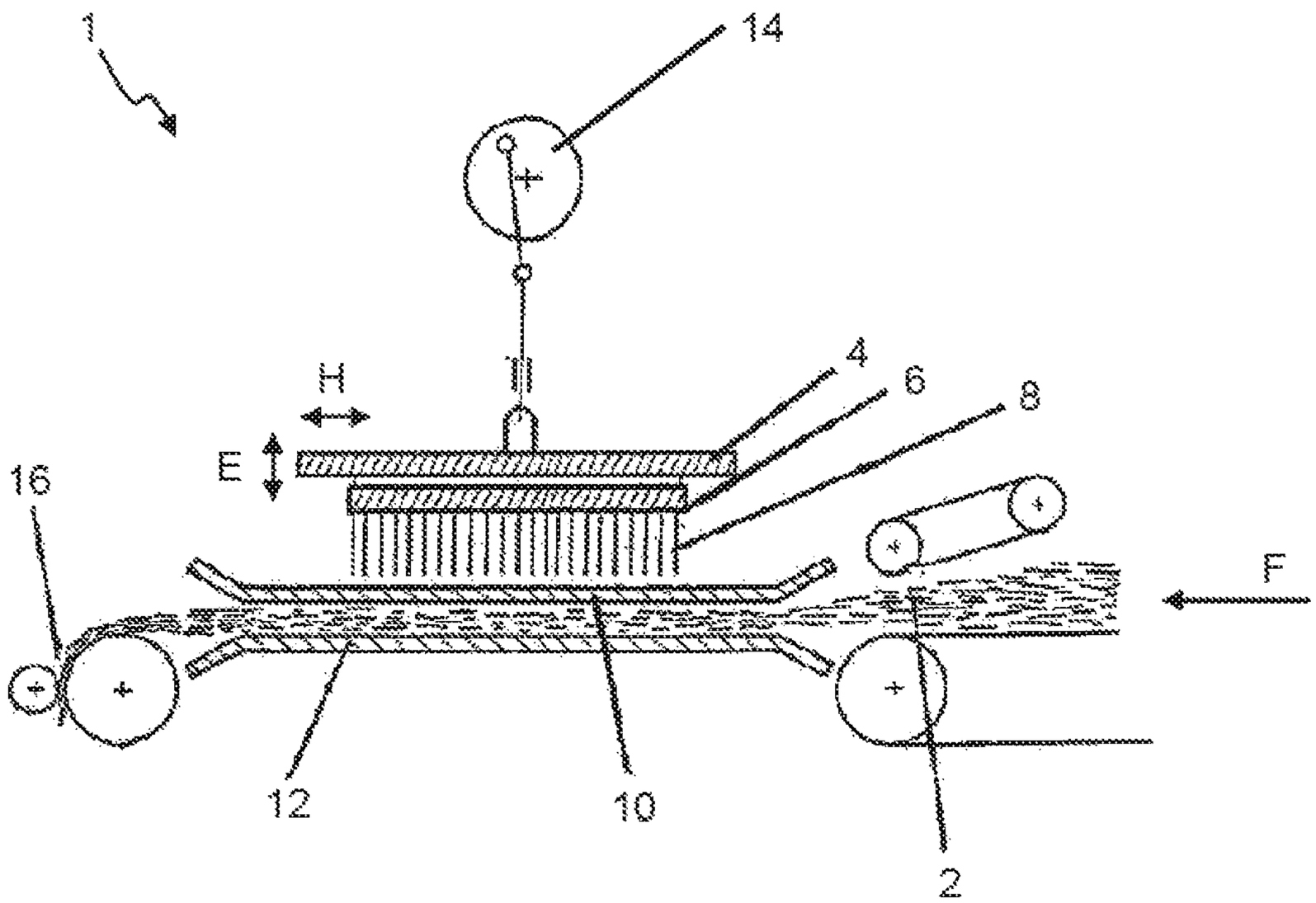

Fig. 1

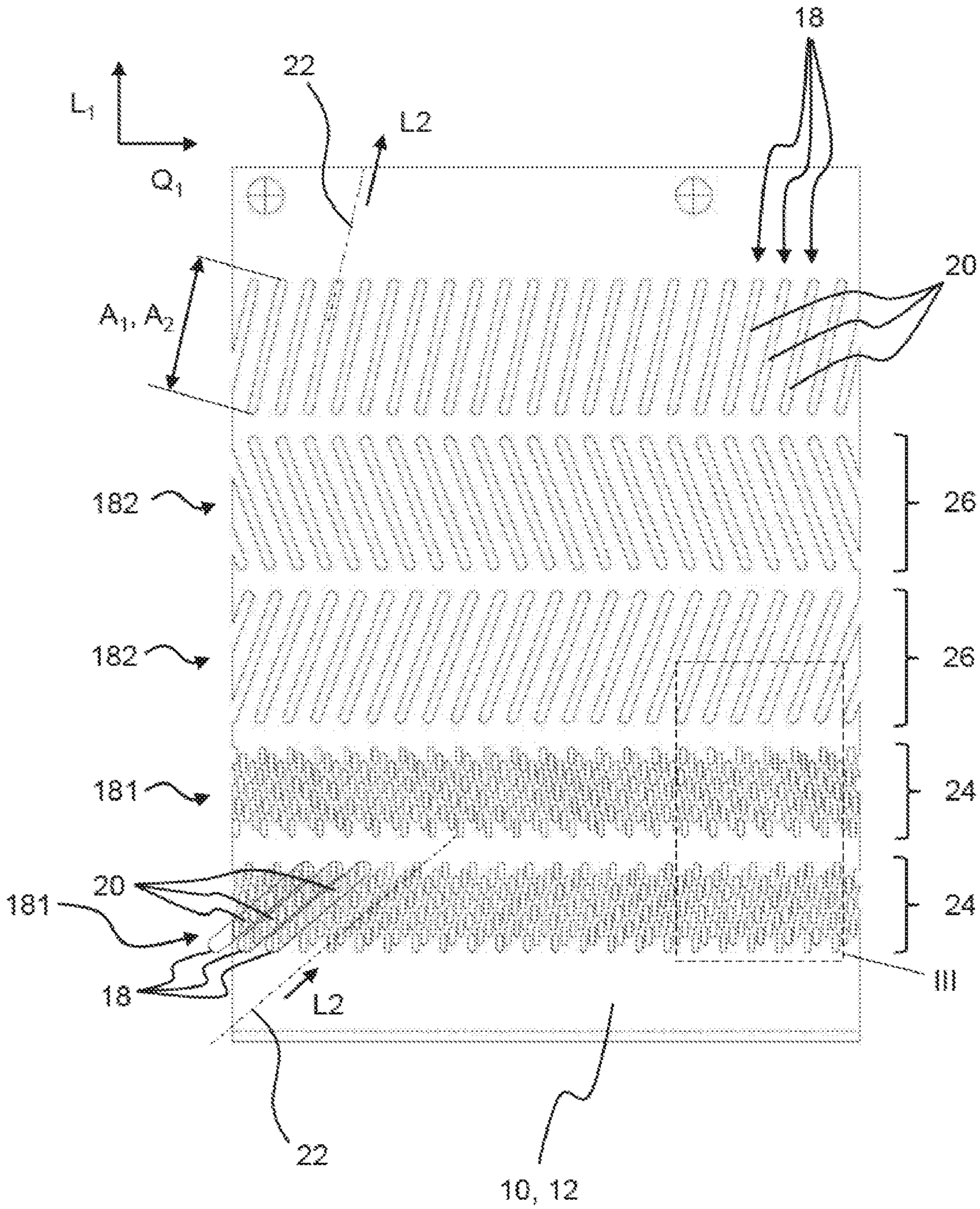
18
22
L1
L2
Q1
20
A1, A2
182
26
182
26
181
24
20
24
181
III
18
L2
22
10, 12

Fig. 2

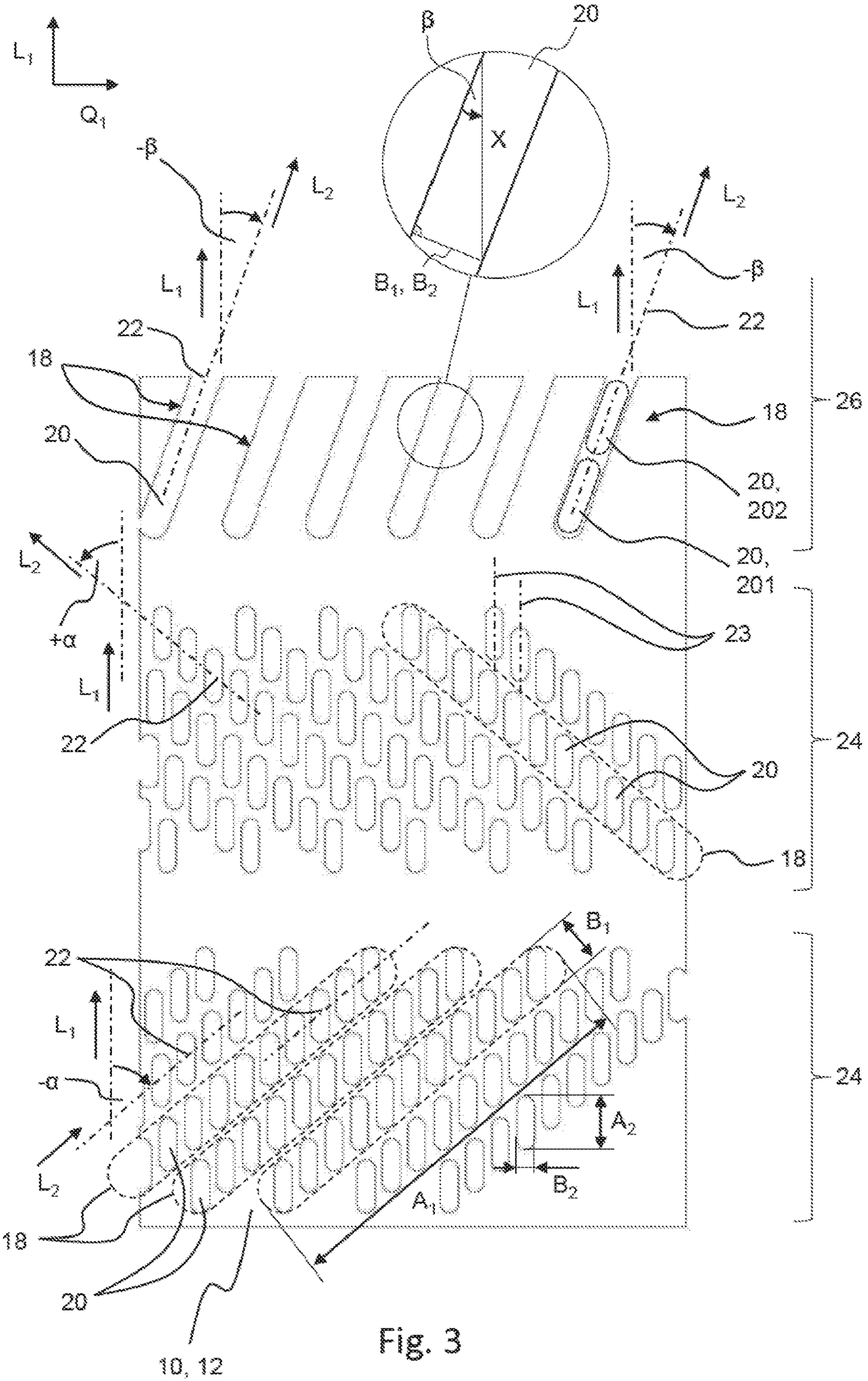
L1
Q1
-β
L2
L1
22
18
20
β
20
X
B1, B2
L2
-β
L1
22
26
18
20, 202
20, 201
23
+α
L1
22
24
20
18
B1
22
L1
-α
A2
L2
B2
A1
18
20
10, 12
24

Fig. 3

STRIPPER PLATE AND STITCHING PLATE FOR A NEEDLING MACHINE

FIELD OF THE INVENTION

The invention relates to a stripper plate and to a stitching plate for a needling machine for the needling of textile fabric such as nonwoven material, woven fabric, or interlaid scrim.

Needling machines are generally known and are described in, for example, *Vliesstoffe* [*Nonwovens*] by Lünenschloss and Albrecht, Georg-Thieme-Verlag, Stuttgart, 1982, pp. 122-129, and also in *Vliesstoffe* [*Nonwovens*] by Albrecht, Fuchs, and Kittelmann, Wiley-VCH Verlag Weinheim, 2000, pp. 270 ff.

When textile fabrics, especially nonwovens, are needled, it is desirable to achieve the most uniform possible needling, i.e., without the formation of patterns in the textile fabric.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a stripper plate and a stitching plate for a needling machine and also a needling machine by means of which it is possible to produce a uniformly needled textile fabric even at a large feed-per-stroke ratio or over a relatively large range of feed rates through the needling machine.

According to an aspect of the invention, a stripper plate or a stitching plate for holding down or supporting a textile fabric in a needling machine for needling the textile fabric comprises a plurality of opening arrangements, wherein each opening arrangement of the plurality of opening arrangements comprises at least one opening and is configured to accommodate needles of one of the rows of needles of a needle board of the needling machine. At least first and second opening arrangements of the plurality of opening arrangements are arranged at a slant to a longitudinal direction of the stripper plate or stitching plate, which direction corresponds to a conveying direction of the textile fabric to be needled in the needling machine. An absolute value of the angle of the second opening arrangements of the plurality of opening arrangements to the longitudinal direction of the stripper plate or stitching plate is different from an absolute value of the angle of the first opening arrangements of the plurality of opening arrangements to the longitudinal direction of the stripper plate or stitching plate.

By varying the angles of the first and second opening arrangements to the longitudinal direction of the stripper plate or stitching plate, it becomes possible to arrange the rows of needles of the needle board of the needling machine correspondingly at different angles to the longitudinal direction of the stripper plate or stitching plate. As a result of the different distributions of the needles in the needle board thus achieved, the formation of patternings in the needled textile fabric can be prevented in the vast majority of cases even at high conveying speeds of the textile fabric in the needling machine. At the same time, an appropriately configured stripper plate or stitching plate prevents the needles of the needle board from pulling individual fibers or fiber bundles out of the textile fabric to an undesirable degree or even from pulling them out entirely from it. An appropriately configured stitching plate, furthermore, makes it possible for the needles to pass completely through the textile fabric in order to achieve the most thorough possible reorientation and thus homogeneous needling of the textile fabric without the danger that the needles could collide with the stitching plate supporting the textile fabric.

All of the opening arrangements of the plurality of opening arrangements are preferably configured as first or second opening arrangements, for which reason at least the first and second opening arrangements are covered in all of the descriptions of the opening arrangements given in the following. It is also conceivable that the plurality of opening arrangements could comprise third opening arrangements or additional opening arrangements, which are arranged at additional, different angles to the longitudinal direction of the stripper plate or stitching plate. It is also conceivable that the plurality of opening arrangements could also comprise opening arrangements which extend in the longitudinal direction of the stripper plate or stitching plate.

The opening arrangements of the plurality or opening arrangements are preferably elongated in form. This means that the opening arrangement is longer than it is wide. In addition, each opening arrangement extends lengthwise along a longitudinal axis, and the absolute value of the angle of the opening arrangement to the longitudinal direction of the stripper plate or stitching plate is defined as the angle between the longitudinal axis of the opening arrangement and an axis parallel to the longitudinal direction of the stripper plate or stitching plate.

With respect to the angles of the first and second opening arrangements, it is always the smaller of the two angles of intersection between the longitudinal axis of an opening arrangement and a line parallel to the longitudinal direction of the stripper plate or stitching plate which is considered, wherein the rotational direction is always to be defined as the direction proceeding from the parallel to the longitudinal direction of the stripper plate or stitching plate to the longitudinal axis of the opening arrangement. A counterclockwise rotational direction (mathematically positive direction) is characterized by a plus sign, and a clockwise rotational direction (mathematically negative direction) is characterized by minus sign.

It is also preferred that each opening arrangement of the plurality of opening arrangements accommodate a plurality of the needles of one needle row of the needle board. Each opening arrangement of the plurality of opening arrangements can also accept all of the needles of a needle row. This formulation comprises two alternatives: first, that the at least one opening passes completely through the stripper plate or stitching plate and that the needles of the needle board can pass through the at least one opening. The second alternative is that the at least one opening does not pass completely through the stitching plate but rather is formed as a recess with a bottom. A recess such as this comprises an appropriate depth, so that the needles of the needle board pass through the textile fabric and then enter the at least one recess.

According to a first preferred embodiment, each of the opening arrangements of the plurality of opening arrangements comprises a single opening, which is configured at a slant to the longitudinal direction of the stripper plate or stitching plate. Such an opening then extends uninterruptedly along the longitudinal axis of the opening arrangement, which is itself oriented at an angle to the longitudinal direction of the stripper plate or stitching plate. An opening of this type, furthermore, is also preferably configured to accept all the needles of one row of needles of the needle board. This means that the opening is aligned with a needle row of the needle board, and that the opening is wide enough and long enough to accept the entire row of needles. As a result, the stripper plate or stitching plate comprises the fewest possible number of openings and can thus be pro-

duced easily and at low cost. In addition, the needles of a needle row can be arranged as closely together as possible.

According to a second preferred embodiment, each of the arrangements of openings of the plurality of opening arrangements comprises a plurality of openings, wherein each opening of the plurality of openings of an opening arrangement is configured at a slant to the longitudinal direction of the stripper plate or stitching plate, and the openings of an opening arrangement are arranged in a row extending in the longitudinal direction and thus in the direction of the longitudinal axis of the opening arrangement. The openings of the plurality of openings are then in each case configured with an elongated shape and are preferably oriented with respect to each other in such a way that their longitudinal axes line up and coincide with the longitudinal axis of the associated opening arrangement. Alternatively, the longitudinal axes of the plurality of openings of an opening arrangement can also be offset from each other, in which case, however, they are preferably configured so that they are parallel to each other and parallel to the longitudinal axis of the associated opening arrangement. In another modification of the second embodiment, the openings of an opening arrangement can also have a different geometry, e.g., a circular form, and be arranged in a row extending in the longitudinal direction and thus in the direction of the longitudinal axis of the opening arrangement.

In the second embodiment, the longitudinal axes of the plurality of openings of an opening arrangement are preferably arranged in each case at the same angle to the longitudinal axis of the stripper plate or stitching plate. Each opening is also configured to accept at least one needle or a portion of the needles of a needle row of the needle board. The plurality of openings are otherwise configured as described in general above or as described with reference to the first embodiment.

In the second embodiment, the stripper plate or stitching plate comprises more openings than in the case of the first embodiment, but, in comparison to a stripper plate or stitching plate with one opening for each needle, it will still always have fewer openings, so that it can be produced more easily and at lower cost. In addition, at least some of the needles of the needle row can be arranged as closely together as possible.

According to a third preferred embodiment, each of the opening arrangements of the plurality of opening arrangements comprises a plurality of openings, wherein each opening of the plurality of openings of an opening arrangement is configured so that it is parallel to the longitudinal direction of the stripper plate or stitching plate, and the openings of an opening arrangement are arranged in a row extending at a slant to the longitudinal direction of the stripper plate or stitching plate.

In the third embodiment, each of the openings of the plurality of openings has an elongated shape, so that its longitudinal axis is parallel to the longitudinal direction of the stripper plate or stitching plate. At the same time, the openings of the plurality of openings of an opening arrangement are offset from each other in the longitudinal direction of the stripper plate or stitching plate and in a transverse direction, i.e., transverse to the longitudinal direction of the stripper plate or stitching plate, in such a way that the openings form a row along the longitudinal axis of the associated opening arrangement, this row being oriented at a slant to the longitudinal direction of the stripper plate or stitching plate. This means that a predefined point of each opening, e.g., a center point or an apex point of each opening, is arranged on the longitudinal axis. Each opening of the plurality of openings of an opening arrangement is configured to accept preferably one needle of a needle row of the needle board, but it can also accept a plurality of needles and thus a certain portion of the needles of a needle row of the needle board. The plurality of openings are configured otherwise as previously described in general or as described with reference to the first and second embodiments.

Because each opening of the plurality of openings of an opening arrangement is parallel to the longitudinal direction of the stripper plate or stitching plate, the length of the openings is substantially freely selectable and can, independently of the angle of the opening arrangement in question to the longitudinal direction of the stripper plate or stitching plate, make possible a desired horizontal stroke of the needles. The width of the openings can always be kept small enough to allow them to fulfill their function of holding back the fibers, i.e., of stripping the fibers from the needles.

The plurality of opening arrangements of a stripper plate or stitching plate can be configured according to a single embodiment or can comprise opening arrangements of different embodiments in any desired combinations.

The opening arrangements of the plurality of opening arrangements are preferably arranged in a plurality of blocks, wherein all of the opening arrangements of one block of the plurality of blocks are parallel to each other. Each block of the plurality of blocks comprises a plurality of opening arrangements, wherein these opening arrangements preferably form a row, which preferably extends in the transverse direction of the stripper plate or stitching plate. The blocks of the plurality of blocks are preferably arranged one behind the other in the longitudinal direction of the stripper plate or stitching plate.

To increase the homogenization of the stitching pattern in the needled textile fabric, it is effective to arrange the rows of needles and thus the plurality of blocks of opening arrangements in a herringbone pattern. This is to be understood as an arrangement in which the opening arrangements of the individual blocks are arranged at a slant to the longitudinal direction of the stripper plate or stitching plate in such a way that the angle of the opening arrangements of a block to the longitudinal direction has a certain sign (plus or minus), and the angle of the opening arrangements of a block adjacent to it in the longitudinal direction of the stripper plate or stitching plate has the opposite sign (minus or plus). The angles of the opening arrangements of successive blocks can have the same value, as a result of which a homogeneous herringbone pattern is formed in areas of the stripper plate or stitching plate. The angles of the opening arrangements of successive blocks can also have different values, however.

In a preferred embodiment, the opening arrangements of at least one first block of the plurality of blocks are configured differently from the opening arrangements of at least one second block of the plurality of blocks of opening arrangements. This makes it possible to vary the needling in a wide variety of ways and thus leads to an especially homogeneous stitching pattern in the textile fabric with the fewest possible defects. The opening arrangements of the first block and of the second block can differ, for example, in that they correspond to first or second opening arrangements, in that they are arranged in a herringbone pattern and thus have different angles of inclination relative to the longitudinal direction of the stripper plate or stitching plate, and/or in that the first block comprises opening arrangements of one of the first three embodiments, and the second

block comprises opening arrangements of one of the other two embodiments of the three. It is also conceivable that the opening arrangements of the first and second blocks could have different widths and/or different lengths or that one block comprises differently configured opening arrangements.

It has been found to be especially preferable for the absolute value of the angle of the first opening arrangements to the longitudinal direction of the stripper plate or stitching plate to be between 10° and 30°, preferably between 15° and 25°, and especially preferably between 17° and 23°.

It has also been found advantageous for the absolute value of the angle of the second opening arrangements to the longitudinal direction of the stripper plate or stitching plate to be between 25° and 65°, preferably between 30° and 60°, and especially preferably between 42° and 48°.

A row of needles of a needle board usually comprises between 5 and 40 needles. The needles of one row can be connected to each other, in which case they form a needle module, which is arranged in a slot in the needle board. The length of an opening arrangement of the plurality of opening arrangements corresponds preferably to the length of a needle row and thus depends on the number of needles per needle row of the needle board and on the spacing of the needles within the row.

The width of the at least one opening of an opening arrangement of the plurality of opening arrangements is preferably large enough to prevent reliably the accommodated needles from colliding with the stripper plate or stitching plate even at very high stroke frequencies of, for example, more than 1,500 strokes/minute. In addition, the width is, at the same time, small enough to guarantee that the fibers adhering to the needles of the needle board will be stripped off by the stripper plate. The width of an opening thus depends substantially on the diameter of the needle and on the diameter of the fiber. The width of the at least one opening is preferably no more than 12 mm, preferably no more than 8 mm, more preferably no more than 6 mm.

It has also been found that the distortions within the textile fabric can be reduced even more if the needles of a needle board execute a horizontal stroke. This means that the needles execute a stroking movement in the conveying direction of the textile fabric to be needled while they are at least partially present in the textile fabric. As a result, relative movement in the conveying direction between the fibers of the textile fabric and the needles is minimized, and thus the danger of distortions is reduced. At least certain sections of the at least one opening of the plurality of opening arrangements therefore preferably extend by a predetermined amount parallel to the longitudinal direction of the stripper plate or stitching plate and are configured to make possible a predetermined horizontal stroke of needles of the needle board.

The distance value by which an opening extends parallel to the longitudinal direction of the stripper plate or stitching plate is greater than the desired or predetermined value of the horizontal stroke of the needles of the needle board. In addition to the value of the horizontal stroke of the needle, it is also necessary in particular to take into account the diameter of the needle and to ensure enough tolerance to prevent the needles from colliding with the stripper plate or stitching plate. Depending on the embodiment of the plurality of opening arrangements, this requirement leads to the result that the at least one opening of the plurality of opening arrangements must be either long enough or wide enough to extend by the predetermined value parallel to longitudinal direction of the stripper plate or stitching plate.

If the plurality of opening arrangements is configured according to the first or second embodiment, the minimum width of the at least one opening is therefore preferably obtained by multiplying the predetermined value by the sine of the angle between the associated opening arrangement and the longitudinal direction of the stripper plate or stitching plate.

If the plurality of opening arrangements is configured according to the third embodiment, the length of the at least one opening preferably has a value which corresponds at least to the predetermined value.

It can also be derived simultaneously from the above-described requirement on the maximum width of the at least one opening that, in opening arrangements according to the first and second embodiments, there are limits on the angle between the opening arrangement in question and the longitudinal direction of the stripper plate or stitching plate and also on the predetermined value of the extent of the opening in the longitudinal direction of the stripper plate or stitching plate.

Starting from a certain angle between the opening arrangement in question and the longitudinal direction of the stripper plate or stitching plate, therefore, there is preferably a transition from opening arrangements of the first or second embodiment to opening arrangements according to the third embodiment. Opening arrangements according to the third embodiment make it possible, without changing the width, to increase both the angle of the opening arrangement in question and the predetermined value of the extent in the longitudinal direction of the stripper plate or stitching plate and thus to increase the possible horizontal stroke of the needles.

The sine of the angle between the longitudinal axis of an opening arrangement and a line parallel to the longitudinal direction of the stripper plate or stitching plate is obtained from the ratio of the width of the opening arrangement to the predetermined value of the longitudinal extent. If, for example, the maximum width is fixed at 3 mm, and if a predetermined value of 6 mm is desired, then the sine is found to be 0.5. The maximum angle at which an opening arrangement according to the first and second embodiments can be arranged in order to fulfill this requirement is found correspondingly to be 30°. If the maximum width is not to be exceeded, opening arrangements with a larger angle to the longitudinal direction of the stripper plate or stitching plate are to be configured according to the third embodiment.

It has been found to be especially effective for the horizontal stroke of the needles of the needle board and the predetermined value of the extent of the at least one opening of the plurality of opening arrangements parallel to the longitudinal direction to be between 2 and 12 mm, preferably between 4 and 8 mm.

It is obvious that this principle also includes all intermediate values, preferably in steps of 0.5 mm.

According to another aspect of the invention, a needling machine for needling a textile fabric comprises a needle board comprising a plurality of rows of needles, which are arranged at a slant to a longitudinal direction of the needle board, which direction corresponds to a conveying direction of the textile fabric to be needled in the needling machine, and a stripper plate and/or stitching plate as previously described.

In this way, a needling machine is provided which exhibits the previously described features and offers the cited advantages.

Finally, it is preferable for each opening arrangement of the plurality of opening arrangements to be aligned with a needle row of the plurality of needle rows of the needle board, so that the at least one opening of the associated opening arrangement can accommodate needles of the needle row of the needle board.

The term "nonwoven" is well known in the relevant industry and for purposes of this application the term "nonwoven" will be given its customary meaning. "Nonwoven" means and refers to a material "made of fibers held together by interlocking or bonding."

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a schematic side view of the essential components of a needling machine;

FIG. **2** shows a top view of part of a stripper plate or stitching plate according to the invention; and

FIG. **3** shows a view of a detail of the stripper plate or stitching plate according to FIG. **2**.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

FIG. **1** shows a schematic diagram of the structure of a needling machine **1** from the side. A textile fabric **2** such as a web of nonwoven material is supplied to the entrance to the needling machine **1** and conveyed to a needling zone. A needle bar **4**, to which a needle board **6** is attached, is arranged in the area of the needling zone; needles **8** for solidifying the fabric **2** are mounted on the needle board. In this area, the textile fabric **2** to be needled is guided between a stripper plate **10**, which holds the textile fabric **2** down, and a stitching plate **12**, which supports the textile fabric **2** from underneath in the needling zone. The needles **8** solidify the fabric **2**, in that they are pushed at high frequency into the textile fabric **2** and pulled back out again. During this process, the needles **8** usually pass through openings in the stripper plate **10** and in the stitching plate **12**. The stitching plate **12**, however, can also comprise openings which do not pass all the way through the plate but which are instead only deep enough to accommodate the tips of the needles **8** passing through the fabric **2**. A drive **14**, which is configured as a connecting rod drive, for example, is preferably provided to move the needles **8** up and down in a stitching direction E.

To prevent the fabric **2** from becoming distorted as the fabric is being moved further onward in a conveying direction F while the needles **8** are still present in the fabric **2**, the needle board **6** with the needles **8**, in a preferred embodiment of a needling machine **1**, executes a horizontal stroke H parallel to the conveying direction F. The needle board **6** with the needles is movable in the conveying direction F along with the textile fabric **2**. Especially while the needles **8** are present in the fabric **2**, the needles **8** are moved along with the fabric **2** to minimize the relative movement between the needles **8** and the fabric **2**. To bring about the horizontal stroke H, either a secondary drive acting on the needle board **6** can be provided, or the drive **14**, in a manner familiar to the skilled person, can be configured appropriately, i.e., coupled to the needle bar **4** in a certain way.

The resulting product is a solidified textile fabric **16** such as a nonwoven. The skilled person is familiar with a wide variety of types of needling machines **1**, including the double needling machine, in which needling is carried out from above and from below by means of two needle bars; needling machines with a horizontal stroke; and needling machines without a horizontal stroke. It is obvious that the present invention can be applied to various types of needling machines and is not limited to the embodiment of a needling machine **1** described herein. For example, in the case of double needling machines, the stitching plate **12** serves simultaneously as the stripper plate for a needle bar arranged under the fabric **2**.

The needles of a needle board **6** are usually arranged in rows of between 5 and 40 needles. The rows of needles are preferably arranged at a slant to a longitudinal direction of the needle board **6**, which direction is parallel to the conveying direction F of the fabric **2** in the needling machine.

Especially with respect to their arrangement and possibly also with respect to their shape, the openings in the stripper plate preferably correspond to the openings in the stitching plate **12**. The present invention can therefore be explained in the following on the basis of the parts of the single plate shown in FIGS. **2** and **3** and will apply equally to a stripper plate **10** and to a stitching plate **12**.

Each of FIGS. **2** and **3** shows a part of a stripper plate **10** or stitching plate **12** according to the invention, wherein the part according to FIG. **3** corresponds approximately to the area in FIG. **2** characterized by the reference symbol III.

The stripper plate **10** or stitching plate **12** comprises a plurality of opening arrangements **18**. Each opening arrangement **18** comprises at least one opening **20** and is configured to accept one row of needles of the needle board **6** of the needling machine **1**. At least first and second opening arrangements **181**, **182**, furthermore, of the plurality of opening arrangements **18** are arranged at a slant to a longitudinal direction L_1 of the stripper plate **10** or stitching plate **12**, which direction corresponds to the conveying direction F of the fabric **2** to be needled in the needling machine. An absolute value of an angle β of the second opening arrangements **182** of the plurality of opening arrangements **18** to the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12** is different from an absolute value of the angle α of the first opening arrangements **181** of the plurality of opening arrangements **18** to the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12**.

In the embodiment shown here, all of the opening arrangements **18** are configured either as first or as second opening arrangements **181**, **182**. As explained above, however, it is also possible to provide in addition any other desired opening arrangements **18**.

The opening arrangements **18** comprise a length A_1 and a width B_1, wherein the length A_1 is greater than the width B_1, so that the opening arrangements **18** have an elongated shape. The opening arrangements **18**, furthermore, extend with respect to their length A_1 along a longitudinal axis **22**, which defines a longitudinal direction L_2 of the opening arrangement **18** in question. The angles α, β of the plurality of opening arrangements **18** to the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12** are defined as the angles between the longitudinal axis **22** in question and a line parallel to the longitudinal direction L_1.

The opening arrangements **18** of the plurality of opening arrangements **18** can be configured in a wide variety of different ways. As one example, it is possible to provide, next to first opening arrangements **181** and second opening arrangements **182**, which differ with respect to the angle between their associated longitudinal axis **22** and the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**, third and additional opening arrangements which are at angles to the longitudinal direction L_1 which are different from angles α and β. As another example, the opening

arrangement **18**, including the first opening arrangements **181**, the second opening arrangements **182**, or optional additional opening arrangements, can be configured in accordance with one of the embodiments explained below.

According to a first embodiment, an opening arrangement **18** comprises a single opening **20**, which is arranged at a slant to the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**. This opening **20** then has an uninterrupted shape extending along the longitudinal axis **22** of the opening arrangement **18**, wherein the longitudinal axis **22** is oriented at a slant to the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12**. In FIGS. **2** and **3**, the second opening arrangements **182** are configured according to this first embodiment. The opening **20** preferably comprises a length A_2 which corresponds to the length A_1 of the associated opening arrangement **18** and which is designed to accommodate a row of needles **8** of the needle board **6** of the needling machine **1**.

FIG. **3** shows by way of example two openings **201** and **202** representing the openings **20** of an opening arrangement **18** according to a second embodiment. Such an opening arrangement **18** comprises a plurality of openings **20** or **201**, **202**, wherein each of the openings **20**, **201**, **202** is arranged at a slant to the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**. In addition, the openings **20**, **201**, **202** of this opening arrangement **18** are arranged in a row in the longitudinal direction L_2 of the opening arrangement **18**, i.e., along its longitudinal axis **22**.

Each of the openings **201**, **202** has an elongated shape and comprises a longitudinal axis. The openings **201**, **202** are preferably oriented with respect to each other in such a way that their longitudinal axes are aligned with each other. The longitudinal axes of the openings **201**, **202** preferably also coincide with the longitudinal axis **22** of the opening arrangement in question.

The openings **20** or **201**, **202** according to an opening arrangement **18** of the second embodiment preferably comprise a length which is designed to accommodate at least one needle and preferably a greater part of the needles **8** of a row of needles of the needle board **6**.

Each of the opening arrangements **18** according to a third embodiment comprises a plurality of openings **20**, each opening **20** of which is arranged parallel to the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**. In addition, the openings **20** of an opening arrangement **18** of the third embodiment are arranged in a row which is at a slant to the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**.

In FIGS. **2** and **3**, the first opening arrangements **181** are configured in accordance with the third embodiment. The longitudinal axis **23** of each of these openings **20** is parallel to the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**. In addition, the openings **20** in this embodiment are offset from each other both in the longitudinal direction L_1 and in the transverse direction Q_1 of the stripper plate or stitching plate **10**, **12**, in such a way that they form a row along the longitudinal axis **22** of the opening arrangement **18** in question.

The openings **20** of an opening arrangement **18** according to the third embodiment are preferably dimensioned in such a way that each one accepts one needle **8** of a needle row of the needle board **6**. The openings **20** can also be dimensioned in such a way, however, that they accommodate two or more adjacent needles **8** of a needle row or needles of several needle rows arranged one behind the other.

A stripper plate or stitching plate **10**, **12** according to the invention can comprise opening arrangements according to only one of these embodiments, or it can comprise any desired combinations of opening arrangements **18** of different embodiments. In particular, alternative embodiments of opening arrangements **18** which are nevertheless arranged according to the invention are also conceivable.

Unless otherwise described, the configurations and features described herein pertain to all of the embodiments of opening arrangements **18**.

The opening arrangements **18** of the plurality of opening arrangements **18** can be arranged in a plurality of blocks **24**, **26**. The opening arrangements **18** of a block **24**, **26** are preferably arranged parallel to each other and form a row of opening arrangements **18** which extends in the transverse direction Q_1 of the stripper plate or stitching plate **10**, **12**. The blocks **24**, **26** are then arranged one behind the other in the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**. In the transverse direction Q_1 of the stripper plate or stitching plate **10**, **12**, the blocks **24**, **26** can extend over the entire width of the stripper plate or stitching plate **10**, **12** in question or over only portions of them.

According to the preferred embodiment according to FIGS. **2** and **3**, the opening arrangements **18** of the blocks **24**, **26** are arranged in a herringbone pattern. The angle of all the opening arrangements **18** of a block **24**, **26** to the longitudinal direction L_1 comprises a specific sign (plus or minus), which is the opposite (minus or plus) of the angle of all the opening arrangements **18** of an adjacent block **24**, **26**, i.e., adjacent in the longitudinal direction L_1. The opening arrangements **18** of successive blocks **26** and **26** or **24** and **24** have the same absolute value for this angle, whereas the opening arrangements **18** of successive blocks **24** and **26** have different absolute values for this angle.

In the case of the stripper plate or stitching plate **10**, **12** illustrated in FIGS. **2** and **3**, a first block **24** comprises first opening arrangements **181** of the plurality of opening arrangements **18**, and a second block **26** comprises second opening arrangements **182** of the plurality of opening arrangements **18**. In addition, the opening arrangements **18**, **181** of the first block **24** are configured in accordance with the third embodiment, whereas the opening arrangements **18**, **182** of the second block **26** are configured in accordance with the first embodiment. Various combinations are conceivable here as alternatives.

Regardless of how an opening **20** is configured, it has a width B_2, which must be large enough to prevent reliably the at least one needle **8** to be accommodated in this opening **20** from colliding with the stripper plate or stitching plate **10**, **12** in the area of this opening **20**. The width B_2 of an opening **20** is therefore greater than the diameter of a needle **8** to be accommodated. At the same time, the width B_2 of an opening **20** must be small enough that the stripping-off of adhering fibers from the needles **8** by the stripper plate or stitching plate **10**, **12** is guaranteed.

To make it possible for the needle board **8** and the needles **8** to execute a horizontal stroke H, at least certain sections of the at least one opening **20** of the plurality of opening arrangements **18** preferably extend by a predetermined value X parallel to the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12** and are designed to allow the needles **8** to execute the predetermined horizontal stroke H. As a result, the needles **8** are given sufficient freedom of movement in the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12** and thus in the conveying direction F of the textile fabric **2** so that they can execute a horizontal stroke H.

It follows from this that the value X of the distance parallel to the longitudinal direction L_1 should be greater than the desired or predetermined value of the horizontal stroke H of the needles **8**.

Depending on the configuration of the plurality of opening arrangements **18**, different requirements are thus imposed on their dimensions. In particular, the openings **20** of the plurality of opening arrangements **18** must either be long enough or wide enough to allow them to extend by the predetermined distance value X parallel to the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12**.

In the case of opening arrangements **18** according to the first and second embodiments, the openings **20** provided in each case are at a slant to the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12**. The value X of the distance by which an opening **20** extends in the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12** therefore depends on the width B_2 of the associated opening **20**. The length A_2 of the opening however, is less limiting with respect to the value X, but it must also be taken into account especially in the case of the second embodiment.

As can be derived from the detailed view of an opening **20** of an opening arrangement contained in FIG. **3**, a minimum width B_2 stands in a certain relationship to the predetermined value X by way of the angles α, β between the longitudinal direction L_1 of the stripper plate **10** or stitching plate **12** and the longitudinal axis **22** of the associated opening arrangement **18**. The mathematical relationship between the angles α or β, the width B_2, and the value X is found to be:

$$\sin(\alpha,\beta)=B_2/X.$$

Correspondingly, a minimum width B_2 for a desired predetermined value X is obtained by multiplying the sine of the angle α, β in question by the value X. By proceeding in the opposite direction, one can use this relationship to determine a maximum angle at which a maximum allowable width can still be reached for a predetermined value X.

It is obvious that, as the value of the angle α, β increases, the required width B_2 of an opening **20** increases in order to reach the same predetermined value X of the distance in the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**. Because, starting from a certain width B_2 of an opening **20**, e.g., a width of greater than 6 mm, the function of the stripper plate **10** or stitching plate **12** is not reliably fulfilled in all cases, there is a limit on the maximum value X of the distance in the longitudinal direction L_1 of the openings **20** of these opening arrangements **18** which can be achieved with the opening arrangements **18** according to the first and second embodiments.

So that it is possible to obtain large values X of the distance in the longitudinal direction L_1 or larger angles α, β of the opening arrangements **18** to the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**, the openings **20** of the opening arrangements **18** can therefore be configured in accordance with the third embodiment.

The openings **20** of the opening arrangements **18** according to the third embodiment are parallel to the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**. The key factor in their ability to allow a horizontal stroke H of the needles **8** in the conveying direction F is therefore substantially the length A_2 of the openings **20**. The length A_2 of an opening **20** therefore corresponds preferably at least to the predetermined value X of the distance in the longitudinal direction L_1. As a result, the openings **20** can be made narrow, i.e., their width B_2 can be reduced, whereas they simultaneously can be adapted by way of their length A_2 to the desired horizontal stroke H.

Because the various openings **20** of an opening arrangement **18** according to the third embodiment are at the same time arranged along the longitudinal axis **22** of the opening arrangement **18**, which is itself oriented at a slant to the longitudinal direction L_1 of the stripper plate or stitching plate **10**, **12**, it is simultaneously made possible for the associated row of needles of the needle board **6** also to be arranged at a slant to the longitudinal direction L_1 or to the conveying direction F of the textile fabric **2** in the needling machine in order to achieve a textile fabric which has been needled with the greatest possible uniformity.

The invention claimed is:

1. A stripper plate or stitching plate for holding down or supporting a textile fabric in a needling machine for needling the textile fabric,

wherein the stripper plate or stitching plate comprises a plurality of opening arrangements;

wherein each opening arrangement of the plurality of opening arrangements comprises a plurality of openings and is configured to accommodate needles of one row of needles of a needle board of the needling machine;

wherein at least first and second opening arrangements of the plurality of opening arrangements are arranged at a slant to a longitudinal direction (L_1) of the stripper plate or stitching plate, wherein the longitudinal direction (L_1) of the stripper plate or stitching plate corresponds to a conveying direction of the fabric to be needled in the needling machine;

wherein each opening of the plurality of openings is configured to be parallel to the longitudinal direction (L_1) of the stripper plate or stitching plate, and wherein the openings of an opening arrangement are arranged in a row which extends at a slant to the longitudinal direction (L_1) of the stripper plate or stitching plate; and

wherein an absolute value of an angle (β) of the second opening arrangements of the plurality of opening arrangements to the longitudinal direction (L_1) of the stripper plate or stitching plate is different from an absolute value of an angle (α) of the first opening arrangements of the plurality of opening arrangements to the longitudinal direction (L_1) of the stripper plate or stitching plate.

2. The stripper plate or stitching plate of claim **1** wherein the opening arrangements of the plurality of opening arrangements are arranged in a plurality of blocks, wherein all of the opening arrangements of a block of the plurality of blocks are parallel to each other.

3. The stripper plate or stitching plate of claim **2** wherein the plurality of blocks of opening arrangements are arranged in a herringbone pattern.

4. The stripper plate or stitching plate of claim **2** wherein the opening arrangements of at least one first block of the plurality of blocks are configured differently from the opening arrangements of at least one second block of the plurality of blocks of opening arrangements.

5. The stripper plate or stitching plate of claim **1** wherein the absolute value of the angle of the first opening arrangements to the longitudinal direction (L_1) of the stripper plate or stitching plate is between 10° and 30°.

6. The stripper plate or stitching plate of claim **1** wherein the absolute value of the angle (β) of the second opening arrangements to the longitudinal direction (L_1) of the stripper plate or stitching plate is between 25° and 65°.

7. The stripper plate or stitching plate of claim 1 wherein at least a certain section of the openings of the plurality of opening arrangements is parallel to the longitudinal direction (L_1) of the stripper plate or stitching plate over a predetermined distance value (X) and is thus configured to allow for a predetermined horizontal stroke of needles of a needle board.

8. The stripper plate or stitching plate of claim 7 wherein each opening comprises a length (A_2), wherein a value of the length (A_2) corresponds to the predetermined distance value (X).

9. The stripper plate or stitching plate of claim 7 wherein the predetermined distance value (X) is between 2 and 12 mm.

10. A needling machine for needling a textile fabric, comprising:

a needle board, which comprises a plurality of rows of needles, wherein at least some of the rows are arranged at a slant to a longitudinal direction (L_1) of the needle board, wherein the longitudinal direction (L_1) of the needle board corresponds to a conveying direction of the fabric to be needled in the needling machine; and

a stripper plate or stitching plate for holding down or supporting the textile fabric in the needling machine,

wherein the stripper plate or stitching plate comprises a plurality of opening arrangements;

wherein each opening arrangement of the plurality of opening arrangements comprises a plurality of openings and is configured to accommodate needles of one row of needles of the needle board of the needling machine;

wherein at least first and second opening arrangements of the plurality of opening arrangements are arranged at a slant to the longitudinal direction (L_1) of the stripper plate or stitching plate, which corresponds to the longitudinal direction (L_1) of the needle board,

wherein the longitudinal direction (L_1) of the stripper plate or stitching plate corresponds to a conveying direction of the fabric to be needled in the needling machine;

wherein each opening of the plurality of openings is configured to be parallel to the longitudinal direction (L_1) of the stripper plate or stitching plate, and

wherein the openings of an opening arrangement are arranged in a row which extends at a slant to the longitudinal direction (L_1) of the stripper plate or stitching plate; and

wherein an absolute value of an angle (β) of the second opening arrangements of the plurality of opening arrangements to the longitudinal direction (L_1) of the stripper plate or stitching plate is different from an absolute value of an angle (α) of the first opening arrangements of the plurality of opening arrangements to the longitudinal direction (L_1) of the stripper plate or stitching plate.

11. The needling machine of claim 10 wherein each opening arrangement of the plurality of opening arrangements is aligned with a needle row of the plurality of needle rows of the needle board in order to make it possible for each opening of the associated opening arrangement to accommodate needles of the needle row.

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